MANUAL OF METHODS IN FISHERIES BIOLOGY

compiled by

T. LAEVASTU

Fascicule 4

Section 2. Observations on the physical and chemical environment

2.2 Meteorological observations

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME 1965

© FAO 1965

Printed in Italy

CONTENTS

2.2 Meteorological observations 1

2.2.1 Wind 1

2.2.1.1 Direction 1

2.2.1.2 Force (speed) 1

2.2.1.3 Barometric pressure 5

2.2.2 Air temperature 6

2.2.3 Humidity 11

2.2.4 Precipitation 12

2.2.5 Clouds and weather 12

2.2.6 Visibility 12

2.2.7 Explanation of terms 18

2.2.8 References 21

2.2 METEOROLOGICAL OBSERVATIONS

Meteorological observations should be made during field work in fisheries biology because of the direct and indirect influences exerted by meteorological elements on fish stocks. The state of the weather at a particular time exercises a considerable influence on the behavior of pelagic stocks in surface waters at that time. The amount of daylight in each 24 hours plays a considerable part in determining the level of basic production by phytoflankton. The effect of winds in causing water movements is a primary pactor in the determination of the distribution of nutrient salts.

Records of weather conditions are therefore necessary to the biologist directly, and are indirectly necessary from the use that can be made of them by the oceanographers. Detailed instructions on meteorological observational practices are laid down in WMO Pub. No. 8, especially in Chapter 10. Port meteorological officers in larger ports have further local information, and can check instruments and issue meteorological logbooks. It is in the interest of every observer to make himself familiar with the use and care of his instruments before undertaking routine observations.

Meteorological readings are recorded on an appropriate data sheet (Form 1). When working in small boats near the coast and/or lacking some instruments, short log sheets are used, omitting some data. Only the values obtained during the moment of observation or measurement should be recorded; such values generally have a close relation with the average values for an hour or more preceding the moment when they are taken. Some rules are provided in weather manuals to guide the choice of times and circumstances of meteorological observations, so that these should have maximum representativeness.

Synoptic meteorological observations should be taken at established standard hours (0000, 0600, 1200 and 1800, with intermediate observations at 0300, 0900 and 1500 GMT). Observations for special purposes can be taken at any time and can be recorded in the local time.

2.2.1 **Wind**

2.2.1.1 Direction

Wind direction offshore can be ascertained by observing the motion of true wind waves and ripples, but not of swell waves since these are caused by wind in some distant area. This method is inaccurate for positions close to the shore, because of shelter effects and the reflection of waves; other means must be used, such as observation of the movement of flags, smoke, etc.

Wind direction should be recorded in tens of degrees from true North (01-36).

2.2.1.2 Force (speed)

Wind speed is recorded by reference to the Beaufort scale in conjunction with Captain Petersen's sea and coastal criterion tables (Tables 1 and 2), or is measured with anemometers. When anemometer observations are taken

FORM 1. - METEOROLOGICAL DATA SHEET (AND BT DATA)

(*a*) Anemometer height (*b*) Thermometer height

(*c*) Vessel (*d*) Month (*e*) Year (*f*) Cruise

1	2	3	4	5		6		7	8	9		10	11	12		13		14	15	16	17	18
Time				Wind		Air temp. °C		mb		Clouds			°C	Sea		Swell						
Date				Direction true	Speed	Dry bulb	Wet bulb	Barometer - mb	Weather	Formation	Amount	Visibility	Surf. temp. °C	Direction	Amount	Direction	Amount	BT No.	Slide No.	Speed knots		Observer's initials
Latitude				5.1	5.2	6.1	6.2			9.1	9.2			12.1	12.2	13.1	13.2					
Longitude																						

z

TABLE 1. - BEAUFORT WIND SCALE AND ITS SPECIFICATION FOR SEA AND COASTAL USE

Beaufort scale number	Descriptive term	Coastal criterion [1]	Sea criterion
0	Calm	Calm	Sea like mirror.
1	Light air	Fishing smack just has steerage-way.	Ripples with the appearance of scale are formed but without foam crests.
2	Light breeze	Winds fills the sails of smacks which then travel at about 1-2 knots.	Small wavelets, still short but more pronounced. Crests have a glassy appearance and do not break.
3	Gentle breeze	Smacks under top sails, and make up to 3 knots.	Large wavelets, crests begin to break. Foam of glassy appearance. Perhaps scattered with white horses.
4	Moderate breeze	Good working breeze. Smacks under all sail heel over considerably.	Small waves becoming larger; fairly frequent white horses.
5	Fresh breeze	Smacks shorten sail.	Moderate waves, taking a more pronounced long form; many white horses are formed. Chances of some spray.
6	Strong breeze	Smacks have double reef in main sail. Care required when fishing.	Large waves begin to form; the white foam crests are more extensive everywhere. Probably more spray.
7	Near gale	Smacks remain in harbor and those at sea lie to.	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.

TABLE 1 - (*conclusion*)

Beaufort scale number	Descriptive term	Coastal criterion[1]	Sea criterion
8	Gale	All smacks make for harbor, if near.	Moderately big waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.
9	Strong gale		High waves. Dense streaks of foam along the direction of the wind. Sea begins to "roll." Spray may affect visibility.
10	Storm		Very big waves with long overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea assumes a white appearance. The rolling of the sea becomes heavy and shock-like. Visibility affected.
11	Violent storm		The conditions become progressively worse.
12	Hurricane		

[1] The fishing smack in this table may be taken as representing a trawler of average type and trim. For larger or smaller boats and for special circumstances, allowance must be made.

from a moving ship, it is advisable to draw a simple vector diagram to compute the true wind graphically from observations of the relative wind and the ship's speed and course (Figure 1). Wind speed, if measured by anemometers, should be recorded in knots or meters per second. Anemo-tachometers show the measured wind speed directly on the scale. With simple anemometers it is necessary to divide the measured windway by the number of observation seconds.

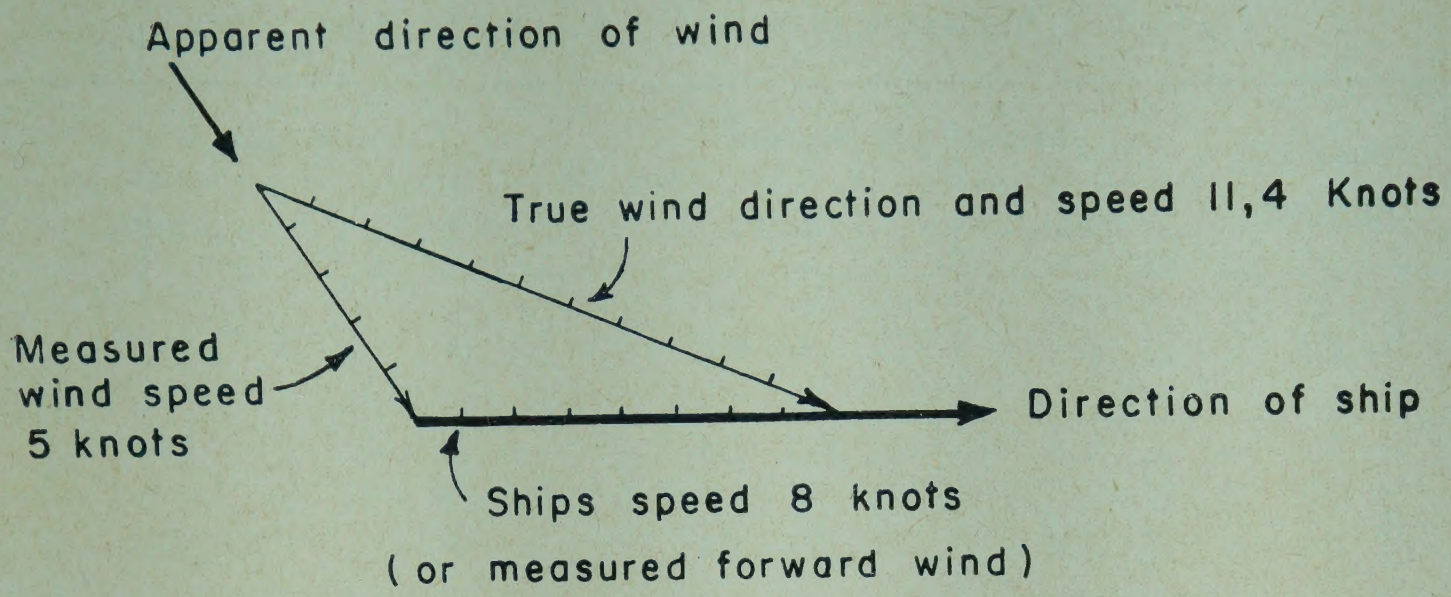

FIGURE 1. - Example of how to obtain true wind speed

2.2.1.3 BAROMETRIC PRESSURE

Pressure is measured either with a mercury barometer or with a precision aneroid. In the case of mercury barometers, the "pumping" effect should be allowed for when a reading is made. This characteristic and the amount of the pressure tendency are obtained with a barograph. Pressure and tendency should be recorded in millibars (for conversion see Table 3). For synoptic reports the pressure should be reduced to gravity at 45° latitude sea level and O°C, but for fisheries purposes such correction may be unnecessary.

Notes on Form 1. Meteorological data sheet (and BT data) [1]

The method of observation and codes to be used for filling this log are given in Section 2. Meteorological observations should be made at: (*a*) every station; (*b*) for every BT lowering; (*c*) the standard hour of observation while underway when the ship is reporting to meteorological offices.

(*a*) (*b*) State the anemometer and thermometer heights above sea level.

1. State Greenwich Mean Time

5.2. State the wind speed in knots if measured with anemometer, otherwise give the force in the Beaufort scale.

7. Give the uncorrected barometer reading in 2 digits neglecting 900 and 1000.

---

[1] In these notes the numbers refer to the column of the Form to which the note relates; letters refer to entries above the columns.

TABLE 5. - MARITIME CONVERSION SCALE FOR WIND SPEED

Beaufort number	Meters per second		Knots	
	mean	limits	mean	limits
0	0	< 0.6	0	1
1	1.5	0.7 - 2.3	3	1 - 4
2	3.4	2.4 - 4.4	7	5 - 8
3	5.6	4.5 - 6.6	11	9-12
4	7.8	6.7 - 8.9	15	13-16
5	10.2	9.0-11.3	19	17-21
6	12.6	11.4-13.8	24	22-26
7	15.1	13.9-16.4	29	27-31
8	17.7	16.5-19.0	34	32-36
9	20.4	19.1-21.8	39	37-42
10	23.3	21.9-24.8	45	43-48
11	26.5	24.9-28.2	52	49-55
12	—	28.2	—	55

2.2.2 **Air temperature**

To obtain a representative measure of air temperature, thermometers should be protected from the sun's radiation, both direct from the sky and reflected from surrounding objects, and at the same time they should be adequately ventilated. Mounted thermometers on ships are generally unsatisfactory. For routine observations there is no advantage in using thermometers which have very rapid response, since air temperature continually fluctuates a degree or two within a few seconds. Conventional thermometers should be read as rapidly as is consistent with accuracy in order to avoid changes of temperature due, for example, to breathing on the thermometer. At sea temperature is usually measured with a psychrometer (Figure 2) of which the dry

TABLE 3. - CONVERSION OF BAROMETRIC PRESSURE FROM MILLIMETERS TO MILLIBARS

mm	0 mb	1 mb	2 mb	3 mb	4 mb	5 mb	6 mb	7 mb	8 mb	9 mb	Decimals	
											Milli-meter	Milli-bar
680	906.6	907.9	909.2	910.6	911.9	913.2	914.6	915.9	917.2	918.6		
690	919.9	921.2	922.6	923.2	925.2	926.6	927.9	929.2	930.6	931.9	1	1
700	933.2	934.6	935.9	937.9	938.6	939.9	941.2	942.6	943.9	945.2	2	3
710	946.6	947.9	949.2	950.6	951.9	953.2	954.6	955.9	957.2	958.6	3	4
720	959.9	961.2	962.6	963.9	965.2	966.6	967.9	969.2	970.6	971.9		
730	973.2	974.6	975.9	977.2	978.6	979.9	981.2	982.6	983.9	985.2	4	5
740	986.6	987.9	989.2	990.6	991.9	993.2	994.6	995.9	997.2	998.6	5	7
750	999.9	1001.2	1002.6	1003.9	1005.2	1006.6	1007.9	1009.2	1010.9	1011.9	6	8
760	1013.2	1014.6	1015.9	1017.2	1018.6	1019.9	1021.2	1022.6	1023.9	1025.2	7	9
770	1026.6	1027.9	1029.2	1030.6	1031.9	1033.2	1034.6	1035.9	1037.2	1038.6	8	11
780	1039.9	1041.2	1042.6	1043.9	1045.2	1046.6	1047.9	1049.2	1050.6	1051.9	9	12
790	1053.2	1054.6	1055.9	1057.2	1058.6	1059.9	1061.2	1062.6	1063.9	1065.2		

TABLE 4. - TEMPERATURE CONVERSION - CENTIGRADE TO FAHRENHEIT

°C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
—2	28.40	28.22	28.04	27.86	27.68	27.50	27.32	27.14	26.96	26.78
—1	30.20	30.02	29.84	29.66	29.48	29.30	29.12	28.94	28.76	28.58
—0	32.00	31.82	31.64	31.46	31.28	31.10	30.92	30.74	30.56	30.38
0	32.00	32.18	32.36	32.54	32.72	32.90	33.08	33.26	33.44	33.62
1	33.80	33.98	34.16	34.34	34.52	34.70	34.88	35.06	35.24	35.42
2	35.60	35.78	35.96	36.14	36.32	36.50	36.68	36.86	37.04	37.22
3	37.40	37.58	37.76	37.94	38.12	38.30	38.48	38.66	38.84	39.02
4	39.20	39.38	39.56	39.74	39.92	40.10	40.28	40.46	40.64	40.82
5	41.00	41.18	41.36	41.54	41.72	41.90	42.08	42.26	42.44	42.62
6	42.80	42.98	43.16	43.34	43.52	43.70	43.88	44.06	44.24	44.42
7	44.60	44.78	44.96	45.14	45.32	45.50	45.68	45.86	46.04	46.22
8	46.40	46.58	46.76	46.74	47.12	47.30	47.48	47.66	47.84	48.02
9	48.20	48.38	48.56	48.74	48.92	49.10	49.28	49.46	49.64	49.82
10	50.00	50.18	50.36	50.54	50.72	50.90	51.08	51.26	54.44	51.62
11	51.80	51.98	52.16	52.34	53.52	52.70	52.88	53.06	53.24	53.42
12	53.60	53.78	53.96	54.44	54.32	54.50	54.68	54.86	55.04	55.22
13	55.40	55.58	55.76	55.94	56.12	56.30	56.48	56.66	56.84	57.02
14	57.20	57.38	57.56	57.74	57.92	58.10	58.28	58.46	58.64	58.82
15	59.00	59.18	59.36	59.54	59.72	59.90	60.08	60.26	60.44	60.62
16	60.80	60.98	61.16	61.34	61.52	61.70	61.88	62.06	62.24	62.42
17	62.60	62.78	62.96	63.14	63.32	63.50	63.68	63.86	64.04	64.22
18	64.40	64.58	64.76	64.94	65.12	65.30	65.48	65.66	65.84	66.02

21	69.80	69.98	70.16	70.34	70.52	70.70	70.88	71.06	71.24	71.42
22	71.60	71.78	71.96	72.14	72.32	72.50	72.68	72.86	73.04	73.22
23	73.40	73.58	73.76	73.94	74.12	74.30	74.48	74.66	74.84	75.02
24	75.20	75.38	75.56	75.74	75.92	76.10	76.28	76.46	76.64	76.82
25	77.00	77.18	77.36	77.54	77.72	77.90	78.08	78.26	78.44	78.62
26	78.80	78.98	79.16	79.34	79.52	79.70	79.88	80.06	80.24	80.42
27	80.60	80.78	80.96	81.14	81.32	81.50	81.68	81.86	82.04	82.22
28	82.40	82.58	82.76	82.94	83.12	83.30	83.48	83.66	83.84	84.02
29	84.20	84.38	84.56	84.74	84.92	85.10	85.28	85.46	85.64	85.82
30	86.00	86.18	86.36	84.54	86.72	86.90	87.08	87.26	87.44	87.62
31	87.80	87.98	88.16	88.34	88.52	88.70	88.88	89.06	89.24	89.42
32	89.60	89.78	89.96	90.14	90.32	90.50	90.68	90.86	91.04	91.22
33	91.40	91.58	91.76	91.94	92.12	92.30	92.48	92.66	92.84	93.02
34	93.20	93.38	93.56	93.74	93.92	94.10	94.28	94.46	94.64	94.82
35	95.00	95.18	95.36	95.54	95.72	95.90	96.08	96.26	96.44	96.62
36	96.80	96.98	97.16	97.34	97.52	97.70	97.88	98.06	98.24	98.42
37	98.60	98.78	98.96	99.14	99.32	99.50	99.68	99.86	10.04	100.22
38	100.40	100.58	100.76	100.94	101.12	101.30	101.48	101.66	101.84	102.02
39	102.20	102.38	102.56	102.74	102.92	103.10	103.28	103.46	103.64	103.82
40	104.00	104.18	104.36	104.54	104.72	104.90	105.08	105.26	105.44	105.62
41	105.80	105.98	106.16	106.34	106.52	106.70	106.88	107.06	107.24	107.42
42	107.60	107.78	107.96	108.14	108.32	108.50	108.68	108.86	109.04	109.22
43	109.40	109.58	109.76	109.94	110.12	110.30	110.48	110.66	110.84	111.02
44	111.20	111.38	111.56	111.74	111.92	112.10	112.28	112.46	112.64	112.82
45	113.00	113.18	113.36	113.54	113.72	113.90	114.08	114.26	114.44	114.62
46	114.80	114.98	115.16	115.34	115.52	115.70	115.88	116.06	116.24	116.42
47	116.60	116.78	116.96	117.14	117.32	117.50	117.68	117.86	118.04	118.22
48	118.40	118.58	118.76	118.94	119.12	119.30	119.48	119.66	119.84	120.02
49	120.20	120.38	120.56	120.74	120.92	121.10	121.28	121.46	121.64	121.82

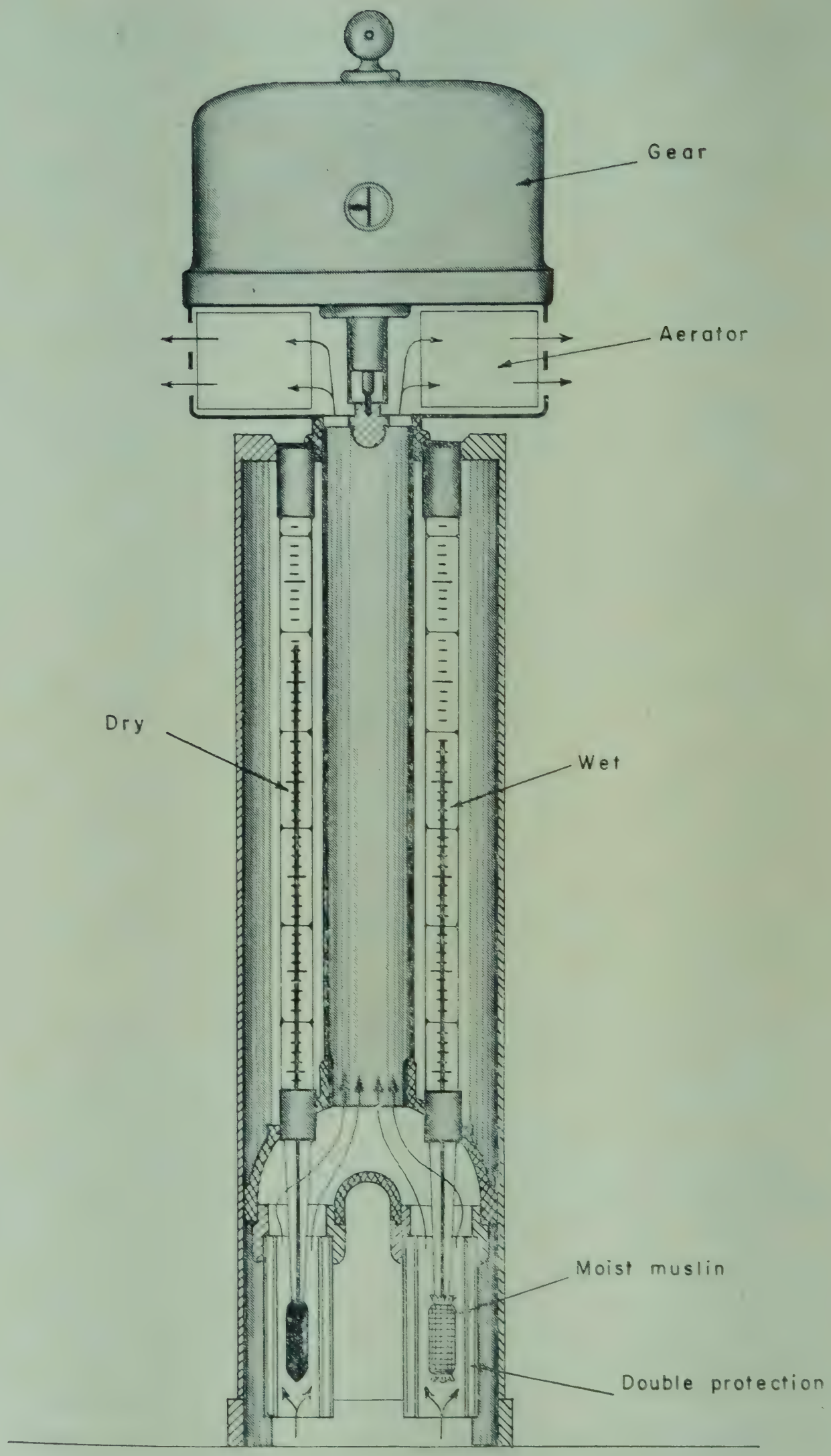

FIGURE 2. - Asmann's aspiration psychrometer

thermometer records the air temperature. (See further under Humidity measurements.)

There are several types of thermograph in use. The requirements for and the handling of these instruments is described in WMO Pub. No 8. It is usually sufficient to record the air temperature with an accuracy of $\pm$ O.5°F or $\pm$ 0.25°C. (A Fahrenheit to Centigrade conversion table is given in Table 4.)

FIGURE 3. - Hair hygrometer
(Courtesy Fuess, Berlin - Steglitz)

2.2.3 **Humidity**

Air humidity is measured either with hygrometers (Figure 3) or psychrometers (Figure 2). The latter (the so-called wet and dry bulb thermometer) is the commonest form in use at sea. Psychrometers must be well exposed in a stream of air fresh from the sea. The wet bulb is moistened with distilled water. If the ventilation of the psychrometer is operated manually,

the thermometer must be read as soon as possible after ventilation has stopped. Psychrometers operated electrically (with battery) can be read during ventilation.

2.2.4 **Precipitation**

There are difficulties in the measurement of the amount of precipitation at sea and there are no satisfactory rain gauges for use on small vessels. Therefore, it is sufficient to record the kind and intensity of precipitation at the hour of observation and the weather of the previous hour by using the symbols in Table 5 and Figure 4.

2.2.5 **Clouds and weather**

The form, amount and direction of movement of clouds observed at sea should be recorded. The form can be noted by use of a cloud atlas. An abridged illustration of cloud forms is shown in Figure 5 and the code for cloud types in Table 6. The amount of cloud should be estimated in 1/8 of the sky, according to the code in Table 7. "Traces" of cloud should be included under scale No. 1 which should be used for amounts up to 1/8. "Overcast but with openings" should be included under scale No. 9. Direction of cloud movement should be reported at the direction from which the clouds come and should be expressed in 10^{o} as for winds (01-36).

All weather phenomena, such as lightning and fog, should be recorded by the symbols in Table 8 or Figure 4.

The observer should be familiar with this Table before selecting code numbers to describe weather. It is sometimes advisable to select the corresponding decade number in the first vertical column and follow this line horizontally until the most correct description of the weather is found.

2.2.6 **Visibility**

To estimate visibility for higher ranges the appearance of the land when coasting is a useful guide if fixes can be obtained. In the absence of other objects, the appearance of the horizon, as observed from different levels in the ship, may be used as a basis of estimation by experienced observers. At night, navigation lights can give a useful indication of visibility. The visibility code is given in Table 9.

When visibility is not uniform in all directions, it should be estimated or measured in the direction of least visibility and the direction of observation suitably recorded in the log. It is useful also to indicate the cause of low visibility.

Table 5. - Beaufort weather notation

b.	Blue sky, weather with clear or hazy atmosphere
c.	Cloudy, i.e., either detached clouds or a cloud layer with openings
d.	Drizzle
e.	Wet air without rain falling, a copious deposit of water on trees, buildings or riggings
f.	Fog
fg.	Ground fog
fs.	Shallow fog
fe.	Wet fog
g.	Gale
h.	Hail
ks.	Drifting snow
kz.	Duststorm or sandstorm
l.	Distant lightning
m.	Mist: range of visibility 1,100 - 2,200 yards
o.	Overcast, i.e., the whole sky covered with a uniform layer of thick or heavy clouds
p.	Showers (use as prefix)
q.	Squalls
r.	Rain
vs.	Sleet, i.e., rain and snow together
s.	Snow
t.	Thunder
tl.	Thunderstorm
u.	Ugly, threatening sky
v.	Unusual visibility of distant objects
w.	Dew
x.	Hoar-frost
y.	Dry air (less than 60 percent relative humidity)
z.	Haze: range of visibility 1,100 - 2,200 yards
R.	Heavy rain
r.	(Moderate) rain
ro.	Slight rain
pr.	Rain showers
RR.	Continuous heavy rain
rr.	Continuous (moderate) rain
iro.	Intermittent slight rain
pS.	Heavy snow showers

Forms of Meteorological Symbols
approved by the
International Meteorological Organization, Warsaw, 1935.

The occurrence of a phenomenon in the vicinity of the station is denoted by enclosing the symbol within brackets ( ). Indices 0, 2 may be used to denote intensity.

Figure 4. - Forms of meteorological symbols
(*The meteorological glossary*. London, H.M.S.O.)

Table 6. - Code for cloud types

0.	Stratus or fracto-stratus
1.	Cirrus
2.	Cirro-stratus
3.	Cirro-cumulus
4.	Alto-stratus
5.	Alto-cumulus
6.	Strato-cumulus
7.	Nimbo-stratus
8.	Cumulus or fracto-cumulus
9.	Cumulo-nimbus

Table 7. - Code for reporting cloudiness

Scale number	*Amount of cloud*
0.	None.
1.	1 okta or 1/8 of sky covered
2.	2 oktas or 2/8 of sky covered
3.	3 oktas or 3/8 of sky covered
4.	4 oktas or 4/8 of sky covered
5.	5 oktas or 5/8 of sky covered
6.	6 oktas or 6/8 of sky covered
7.	7 oktas or 7/8 of sky covered
8.	8 oktas or sky completely covered
9.	Sky obscured (e.g., by fog) or amount of cloud not recordable owing to darkness

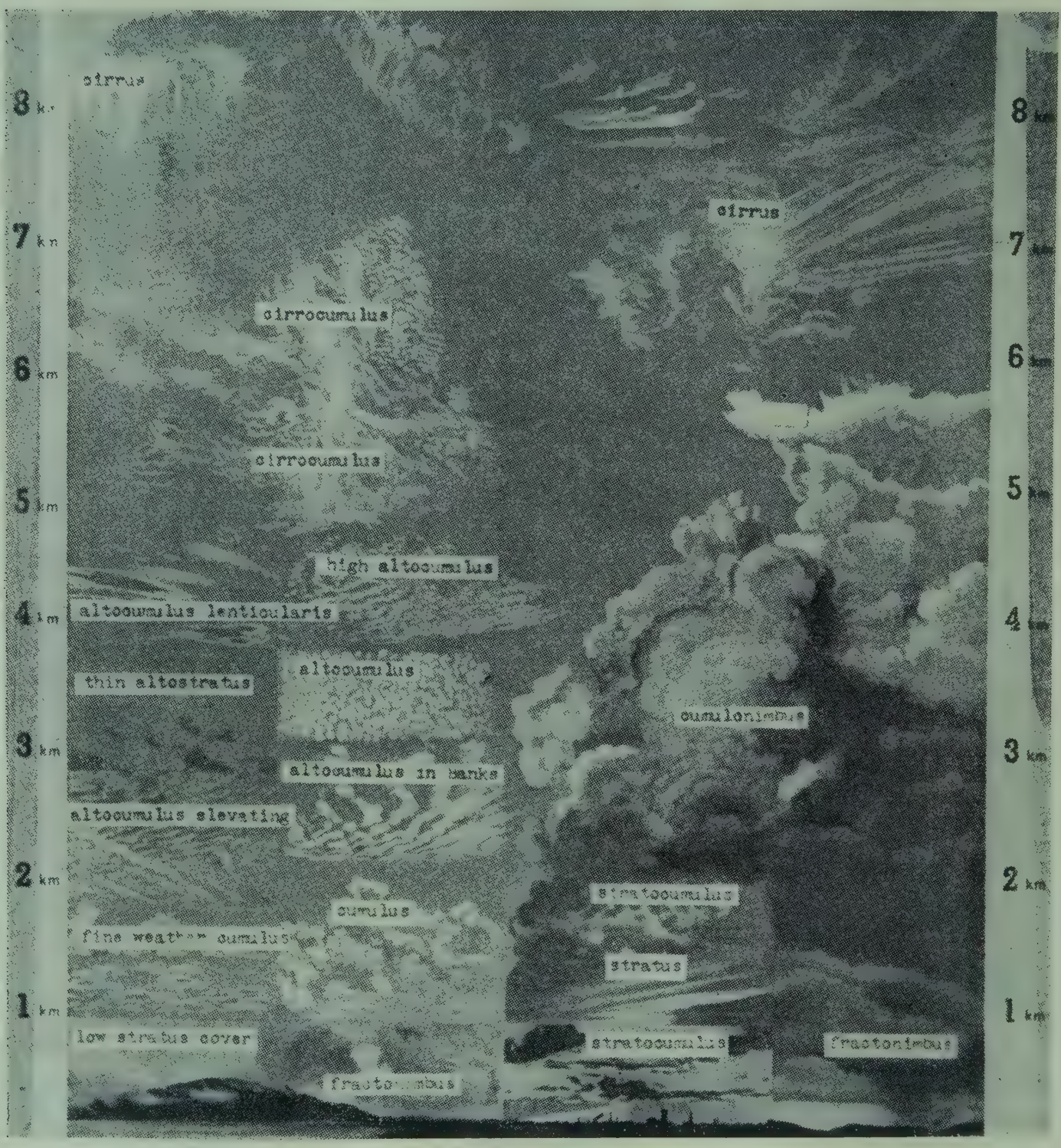

FIGURE 5. - Cloud forms

NUMERICAL WEATHER CODES—PRESENT WEATHER

00 Cloud development NOT observed or NOT observable during past hour	**01** Clouds generally dissolving or becoming less developed during past hour	**02** State of sky on the whole unchanged during past hour	**03** Clouds generally forming or developing during past hour	**04** Visibility reduced by smoke	**05** Haze	**06** Widespread dust in suspension in the air, NOT raised by wind, at time of observation	**07** Dust or sand raised by wind at time of observation	**08** Well developed dust devil(s) within past hour	**09** Duststorm or sandstorm within sight of or at station during past hour
10 Light fog	**11** Patches of shallow fog at station, NOT deeper than 6 feet on land	**12** More or less continuous shallow fog at station, NOT deeper than 6 feet on land	**13** Lightning visible no thunder heard	**14** Precipitation within sight, but NOT reaching the ground	**15** Precipitation within sight, reaching the ground, but distant from station	**16** Precipitation within sight reaching the ground, near to but NOT at station	**17** Thunder heard but no precipitation at the station	**18** Squall(s) within sight during past hour	**19** Funnel cloud(s) within sight during past hour
20 Drizzle (NOT freezing and NOT falling as showers) during past hour, but NOT at time of ob	**21** Rain (NOT freezing and NOT falling as showers) during past hour, but NOT at time of ob	**22** Snow (NOT falling as showers) during past hour but NOT at time of observation	**23** Rain and snow (NOT falling as showers) during past hour, but NOT at time of observation	**24** Freezing drizzle or freezing rain (NOT falling as showers) during past hour but NOT at time of observation	**25** Showers of rain during past hour, but NOT at time of observation	**26** Showers of snow or of rain and snow during past hour but NOT at time of observation	**27** Showers of hail, or of hail and rain during past hour but NOT at time of observation	**28** Fog during past hour but NOT at time of observation	**29** Thunderstorm (with or without precipitation) during past hour but NOT at time of observation
30 Slight or moderate duststorm or sandstorm has decreased during past hour	**31** Slight or moderate duststorm or sandstorm no appreciable change during past hour	**32** Slight or moderate duststorm or sandstorm has increased during past hour	**33** Severe duststorm or sandstorm has decreased during past hour	**34** Severe duststorm or sandstorm, no appreciable change during past hour	**35** Severe duststorm or sandstorm has increased during past hour	**36** Slight or moderate drifting snow, generally low	**37** Heavy drifting snow generally low	**38** Slight or moderate drifting snow, generally high	**39** Heavy drifting snow generally high
40 Fog at distance at time of observation, but NOT at station during past hour	**41** Fog in patches	**42** Fog, sky discernible, has become thinner during past hour	**43** Fog, sky NOT discernible, has become thinner during past hour	**44** Fog, sky discernible, no appreciable change during past hour	**45** Fog sky NOT discernible no appreciable change during past hour	**46** Fog sky discernible, has begun or become thicker during past hour	**47** Fog, sky NOT discernible has begun or become thicker during past hour	**48** Fog depositing rime, sky discernible	**49** Fog depositing rime sky not discernible
50 Intermittent drizzle (NOT freezing) slight at time of observation	**51** Continuous drizzle (NOT freezing) slight at time of observation	**52** Intermittent drizzle (NOT freezing) moderate at time of ob	**53** Continuous drizzle (NOT freezing) moderate at time of ob	**54** Intermittent drizzle (NOT freezing), thick at time of observation	**55** Continuous drizzle (NOT freezing), thick at time of observation	**56** Slight freezing drizzle	**57** Moderate or thick freezing drizzle	**58** Drizzle and rain, slight	**59** Drizzle and rain moderate or heavy
60 Intermittent rain (NOT freezing), slight at time of observation	**61** Continuous rain (NOT freezing), slight at time of observation	**62** Intermittent rain (NOT freezing), moderate at time of ob	**63** Continuous rain (NOT freezing) moderate at time of observation	**64** Intermittent rain (NOT freezing), heavy at time of observation	**65** Continuous rain (NOT freezing), heavy at time of observation	**66** Slight freezing rain	**67** Moderate or heavy freezing rain	**68** Rain or drizzle and snow slight	**69** Rain or drizzle and snow moderate or heavy
70 Intermittent fall of snowflakes, slight at time of observation	**71** Continuous fall of snowflakes, slight at time of observation	**72** Intermittent fall of snowflakes, moderate at time of observation	**73** Continuous fall of snowflakes moderate at time of observation	**74** Intermittent fall of snowflakes, heavy at time of observation	**75** Continuous fall of snowflakes, heavy at time of observation	**76** Ice needles (with or without fog)	**77** Granular snow (with or without fog)	**78** Isolated starlike snow crystals (with or without fog)	**79** Ice pellets (sleet U S definition)
80 Slight rain shower(s)	**81** Moderate or heavy rain shower(s)	**82** Violent rain shower(s)	**83** Slight shower(s) of rain and snow mixed	**84** Moderate or heavy shower(s) of rain and snow mixed	**85** Slight snow shower(s)	**86** Moderate or heavy snow shower(s)	**87** Slight shower(s) of soft or small hail with or without rain or rain and snow mixed	**88** Moderate or heavy shower(s) of soft or small hail with or without rain or rain and snow mixed	**89** Slight shower(s) of hail with or without rain or rain and snow mixed, not associated with thunder
90 Moderate or heavy shower(s) of hail, with or without rain or rain and snow mixed, not associated with thunder	**91** Slight rain at time of ob, thunderstorm during past hour, but NOT at time of observation	**92** Moderate or heavy rain at time of ob, thunderstorm during past hour, but NOT at time of observation	**93** Slight snow or rain and snow mixed or hail at time of observation, thunderstorm during past hour, but not at time of observations.	**94** Mod or heavy snow, or rain and snow mixed or hail at time of ob, thunderstorm during past hour, but NOT at time of observation.	**95** Slight or mod. thunderstorm without hail, but with rain and or snow at time of observation.	**96** Slight or moderate thunderstorm, with hail at time of observation.	**97** Heavy thunderstorm without hail, but with rain and or snow at time of observation	**98** Thunderstorm combined with duststorm or sandstorm at time of observation	**99** Heavy thunderstorm with hail at time of observation

A short meteorological code, useful for fishing (reporting and receiving of meteorological data by fishing vessels as well as for coding of data for logs) is given in Table 10.

TABLE 9. - VISIBILITY CODE

Code	Objects not visible at	Description
0	50 yards	Dense fog
1	200 yards	Thick fog
2	400 yards	Fog
3	1,000 yards	Moderate fog
4	1 nautical mile	Thin fog or mist
5	2 nautical miles	Visibility poor
6	5 nautical miles	Visibility moderate
7	10 nautical miles	Visibility good
8	30 nautical miles	Visibility very good
9	Over 30 nautical miles	Visibility excellent

Note: For eventual conversion into metric system 1 yard = 0.914 m and 1 nautical mile = 1.853 km.

2.2.7 **Explanation of terms**

ANEMOMETER. Instrument for measuring wind speed.

ANEMO-TACHOMETER. Instrument for measuring wind speed. The actual speed can be read directly on the scale.

ANEROID (BAROMETER). A barometer in which the action of atmospheric pressure in bending a metallic surface is made to move a pointer.

CLIMATOLOGY. The science which deals with climates and their effects.

GMT (UNIVERSAL TIME). Greenwich Mean Time. Time based on hour angle of point of definition of mean solar time as measured at Greenwich.

Table 10. - Meteorology code

For use of reporting ships in sparse areas

Group No 1 $YQL_aL_aL_a$

Y = Day of the week
1 = Sunday
2 = Monday
3 = Tuesday
4 = Wednesday
5 = Thursday
6 = Friday
7 = Saturday

Q = Longitude and hemisphere indicator

Northern hemisphere
0 = 0°– 90° West
1 = 90°–180° Wets
2 = 90°–180° East
3 = 0°– 90° East

Southern hemisphere
5 = 0°– 90° West
6 = 90°–180° West
7 = 90°–180° East
8 = 0°– 90° East

$L_aL_aL_a$ = Latitude in degrees and tenths.
Example: 31°28' South = 31.5
$L_aL_aL_a$ = 315

Group No. 3 Nddff

N = Cloud coverage
0 =
2 =
4 = (WMO-Specifications Code 60)
6 =
8 =
9 =

dd = True direction of the wind on the sea surface to the nearest 10°
dd = Pts of compass degrees

00	Calm	
02	NNE	20°
04	NE	40°
06		60°
08	ENE	80°
10	E	100°
12	ESE	120°
14	SE	140°
16	SSE	160°
18	S	180°
20	SSW	200°
22	SW	220°

Group No. 4 VVwwW

VV = Visibility
90 =
91 =
92 =
93 =
94 = (WMO-Specifications Code 84)
95 =
96 =
97 =
98 =
99 =

ww = Present weather
01 =
02 =
03 =
05 =
10 =
16 =
18 =
41 = (WMO-Specifications Code 92)
45 =
52 =
57 =
62 =

Group No. 5 PPXTT

PP = Last two figures of the barometric pressure in millibars.
Examples:
mb PP 30.32" = 1026.8 = 27
749 mm = 998.6 = 99

X = x (Indicator to show type of reporting ship)

TT = Outside air temperature in degrees F or C
Examples:

TT
57°F = 57
19°C = 19
6°C = 06
–2°C = 52

Note. 50 is added to temperatures below 0°C

INSTRUCTIONS

1. In the interest of trans-ocean flying as well as safety of life at sea, your ship is earnestly requested to transmit radio weather reports when off the regular shipping routes.

Table 10. - Meteorology code

For use of reporting ships in sparse areas

Group No 1 $YQL_aL_aL_a$	Group No. 3 Nddff	Group No. 4 VVwwW	Group No. 5 PPXTT
Group No. 2 $L_0L_0L_0GG$ $L_0L_0L_0$ = Longitude in degrees and tenths. Example: 04°05' East = 04.1 $L_0L_0L_0$ = 041 102°10' East = 102.2 $L_0L_0L_0$ = 022 (N.B. The " 1 " is omitted). GG = GMT of the observation to the nearest hour: 00 = 0000 GMT 06 = 0600 " 12 = 1200 " 18 = 1800 " N.B. Please take the observations as near to these times as possible.	24 240° 26 WSW 260° 28 280° 30 WNW 300° 32 NW 320° 34 NNW 340° 36 N 360° ff = Wind speed over sea surface in knots. Knots — Beaufort Force 00 — Calm 02 — 1 05 — 2 09 — 3 13 — 4 18 — 5 24 — 6 30 — 7 37 — 8 44 — 9 52 — 10 60 — 11 68 — 12	67 — 72 — 81 — 86 — 90 — 95 — Choose the largest figure applicable. 41-95: If no figure is suitable, put X in units position. E.g. 6x = rain when neither 62 nor 67 apply. W = Past weather (during the preceding 6 hours). 0 = 1 = 2 = 3 = 4 = (WMO-Specifications Code 90) 5 — 6 — 7 — 8 — 9 —	2. The map provided shows clearly the areas from which weather reports are so urgently needed. DISPLAY IT PROMINENTLY IN YOUR CHARTROOM 3. Address reports to: followed by the name of the nearest coastal radio station shown on the map. There is NO CHARGE to ships for Radio WEATHER messages to these stations. 4. The co-operation of all ships will enable Weather Services to provide better and more reliable shipping and aviation forecasts. 5. Whenever possible have your barometer checked and remember to apply the appropriate correction.

HUMIDITY. The condition of the atmosphere in respect to water vapor.

HYGROMETER. An instrument for determining the humidity of the air (see Figure 3).

PORT METEOROLOGICAL OFFICER. Officer appointed by the meteorological services of corresponding countries to assist and supervise the ships reporting meteorological data.

PSYCHROMETER. An alternative name for the dry and wet bulb hygrometer (see Figure 2).

RAIN GAUGE. An instrument for measuring the amount of rainfall.

SYNOPTIC. A brief or condensed statement presenting a combined or general view of something; e.g., a synoptic chart shows the weather conditions over a large area at a given instant of time.

WMO. World Meteorological Organization.

2.2.8 References

BURGESS, C.R. *Meteorology for seamen.* Glasgow, Brown & Ferguson. 252 p.
1950

AMERICAN METEOROLOGICAL SOCIETY. *Compendium of meteorology*, prepared
1951 under the direction of the Committee on the Compendium of Meteorology; ed. by Thomas F. Malone. Boston. 1334 p.

HALPINE, C.G. & TAYLOR, H.H. *A mariner's meteorology.* London, MacMil-
1955 lan. 372 p.

SMITHSONIAN INSTITUTION. *Smithsonian meteorological tables.* 6th rev. ed.
1951 prepared by R.J. List. Washington, D.C. 527 p. Smithsonian Miscellaneous Collection Vol. 114; Publication 4014.

UNITED KINGDOM. METEOROLOGICAL OFFICE. *The meteorological glossary.*
1939 London, H.M.S.O. 253 p.

UNITED KINGDOM. METEOROLOGICAL OFFICE. *The marine observer's hand-*
1950 *book.* London H.M.S.O. 122 p.

U.S. WEATHER BUREAU. *Instructions for recording and coding marine meteorological observations in the new International Code.* Washington, D.C.

U.S. WEATHER BUREAU. *Manual of cloud forms and codes for state of the sky.*
1951 2nd ed. Washington, D.C. 43 p. Circular S.

U.S. WEATHER BUREAU. *Preparation and use of weather maps at sea.* 4th ed.
1959 Washington, D.C. 121 p. Circular R.

U.S. WEATHER BUREAU. *Manual of marine meteorological observations.* Wash-
1960 ington, D.C. 127 p. Circular M.

WORLD METEOROLOGICAL ORGANIZATION. *Guide to meteorological instrument*
1961 *and observing practice.* 2nd ed. Geneva. WMO Publication 8. TP 3.

Price: $0.50 or 2s 6d

15615/8.65/E/1/3800